Appendix A

Refining
Process Services

Mr. Rob Kromm
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Dear Rob:

Please find enclosed the results of the Ensyn feedstock study. The materials used for this study are described in the following list of hydrocarbon feedstocks. Properties are provided in Table 1 for each of these feedstocks.

1. VGO from upgraded Athabasca bitumen (R243PL / RPS-5693)

2. VGO from upgraded Kerrobert heavy crude (R244PL / RPS-5694)

3. VGO from Alaskan North Slope (ANS) crude oil (KBR-G0254)

4. Hydrotreated VGO from Athabasca bitumen (RPS-5695)

As indicated in Item 4, VGO material from the Athabasca bitumen (RPS-5693) was processed in a hydrotreating pilot plant at PARC Technical Services in Pittsburgh, Pennsylvania. The reactor conditions are listed below:

- Reactor Temperature: 720F
- Reactor Pressure: 1500 psig
- Space Velocity: 0.5
- Hydrogen Rate: 3625 SCFB

As a result of the hydrotreating, API gravity of the upgraded Athabasca material was increased from 14.2 to 22.4. At the same time, sulfur level was reduced by 92.7% from 3.7 weight % to 0.27 weight %. Chemical hydrogen consumption was measured to be about 750 SCFB. Liquid product yield was 96.4 weight % with the remainder going to hydrogen sulfide and light gases.

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Each of the four feedstocks was then evaluated for cracking characteristics by Microactivity (MAT) testing. The MAT testing was performed at the Kellogg Brown & Root (KBR) Technology Center. The test conditions were established by Refining Process Services and are outlined below.

Reaction Temperature: 1000F
Run Time: 30 Seconds
Cat-To-Oil Ratio: 4.5
Catalyst: Equilibrium FCC Catalyst

The results of the MAT testing are presented in Table 2. The results indicate that the cracking conversion for the Athabasca, Kerrobert and Alaskan North Slope (ANS) VGO samples was approximately 63%, 66% and 73% on feed weight. The difference in MAT conversion level between ANS and the two upgraded feedstocks was less than anticipated based upon comparison of the measured aniline point numbers. The full yield structure is presented in the table for each of the feedstocks.

Table 2 also includes conversion and yield data for the hydrotreated Athabasca material. Relative to the ANS VGO, cracking conversion is higher for the hydrotreated material at 74% on feed weight. Product yields are significantly improved versus the raw Athabasca material and they are even better than for the ANS VGO.

Upon completion of the MAT testing, Refining Process Services completed stage one of a computer model study to estimate the cracking characteristics of each feedstock in a commercial FCC operation. We selected a base case for an operating FCC unit that typically cracks ANS VGO as part of a feedstock blend. In the first stage of the study, we input measured inspections including aniline point into the model. In the past, we have found that aniline point typically correlates well with cracking characteristics of a feed. Therefore, the model has been tuned to rely heavily on this factor and so it is important to provide an accurate aniline point number.

Results for stage one of the model study are presented in Tables 3 and 3A. Table 3 presents conversion and yields entirely on the basis of weight % of fresh feed. Table 3A presents conversion and yields on the basis of weight % for light gases and coke and on the basis of volume % for liquid products. The results indicate that predicted cracking conversion for the Athabasca and Kerrobert feedstocks was 21% and 16% on volume lower than for the ANS VGO. Cracking conversion for the hydrotreated Athabasca feedstock was 5% on volume lower than for the ANS VGO.

Conversion difference for the three Ensyn feedstocks relative to the ANS VGO was larger than anticipated based upon comparison with the MAT testing results. Poor cracking characteristics for the untreated feeds leads to high coke yield

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relative to conversion. This results in high regenerator temperature and low catalyst-to-oil ratio which further limits cracking and accelerates coke and light gas production. Therefore, we closely examined the reported aniline points for the Ensyn feedstocks. Using a procedure outlined in the appendix of this report, we estimated aniline point for each material based upon API gravity and distillation data. Based upon this procedure, we estimated that the aniline point for the Athabasca, Kerrobert and hydrotreated Athabasca material would be closer to 135°F, 144°F and 168°F, respectively. Aniline points for these feeds were measured at 110°F, 119°F and 133°F, respectively.

Using the calculated aniline points, we completed a second stage of the FCC model simulation study. The results for this portion of the study are presented in Tables 4 and 4A on a weight % and volume % basis, respectively. The results of the second set of model simulation runs indicate that cracking conversion would increase by 5% to 6% on volume for each Ensyn feedstock while the ANS VGO would not change. Product yields increase accordingly and the results are now more in line with the cracking differences experienced via the MAT testing. We believe that the results presented in Tables 4 and 4A are much more realistic and should be used for feedstock valuation purposes.

In our original meeting with Ensyn, it was reported that the upgraded feedstocks should crack to a greater extent than would be apparent by examining the physical inspections. This appears to be the case. The hydrocarbon composition data developed by Core Labs indicates that the upgraded feeds contain close to 38% mono-aromatics plus thiophene aromatics. These types of molecules have significant amounts of side chains available for cracking and therefore provide higher levels of conversion and light liquid product.

At the bottom of each table are the value differentials between ANS VGO and the three Ensyn feedstocks based upon FCC product value. The basis for this calculation is a set of recent product values for the U.S. Gulf Coast.

After you have had a chance to review the results of this analysis, please call if you have questions or would like to discuss the results in more detail. We have enjoyed the opportunity to work with you on this assignment and hope that we might work together in the future.

Sincerely,

Dennis Kowalczyk

Dennis Kowalczyk
Refining Process Services, Inc.

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Table 1
Ensyn Feed Study

	Athabasca Upgrade	Kerrobert Upgrade	Alaskan North Slope VGO	Hydrotreated Athabasca Upgrade
ID	R243PL	R244PL	KBR-G0254	NA
RPS No.	5693	5694	NA	5695
API Gravity	13.8	15.6	21.7	22.4
Sulfur, Wt%	3.93	3.06	1.1	0.27
Distillation Type: °F	D1160	D1160	D1160	D2887
IBP	619	639	469	246
5%	660	664	615	478
10%	671	672	664	546
20%	684	688	718	609
30%	696	701	750	641
40%	716	722	786	665
50%	742	751	811	690
60%	783	787	833	726
70%	821	821	864	767
80%	860	855	895	811
90%	902	893	934	868
95%	937	920	973	910
EP	965	961	1032	1005
Aniline Point: °F	110	119	168	133.4
Total Nitrogen, ppm	2392	1617	1500	1100
Basic Nitrogen, ppm	859	489	416	NA
Nickel: ppm	NA	NA	1	NA
Vanadium: ppm	NA	NA	0.7	NA
Carbon Residue, Wt%	0.6	0.4	0.38	NA

File: Ensyn

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Table 2
MAT Testing Results

KBRTC MAT Comparison				
Run Number	811	812	815	814
Date	04/24/2000	04/24/2000	04/27/2000	04/24/2000
Catalyst Number	G-0382	G-0382	G-0382	G-0382
Oil Feed Number	RPS-5693	RPS-5694	KBR-G-0254	RPS-5695
Co. Supplying Feedstock	RPS-5693	RPS	KBR	RPS
Special Features	0	0	0	0
Catalyst Charge (grams)	4.5054	4.5061	4.5064	4.5056
Feed Charge (grams)	1.0694	1.0553	1.0188	1
Catalyst/Oil Ratio	4.2	4.3	4.4	4.5
Preheat Temperature (°F)	1015	1015	1015	1015
Bed Temperature (°F)	1000	1000	1000	1000
Oil Inject Time (sec)	30	30	30	30
Conversion (Wt%)	82.75%	65.92%	73.02%	74.08%
Normalized Wt%				
H_2S	2.22%	1.90%	0.79%	0.13%
H_2	0.19%	0.18%	0.17%	0.24%
CH_4	1.44%	1.33%	1.12%	1.07%
C_2H_2	0.00%	0.00%	0.00%	0.00%
C_2H_4	1.01%	1.05%	0.97%	0.93%
C_2H_6	1.03%	0.94%	0.76%	0.66%
C_3H_4	0.00%	0.00%	0.00%	0.00%
C_3H_8	4.11%	4.39%	5.15%	4.65%
C_3H_6	1.01%	1.06%	1.16%	1.01%
C_4H_6	0.00%	0.00%	0.00%	0.00%
$1\text{-}C_4H_8$	0.90%	1.02%	1.19%	1.09%
$i\text{-}C_4H_8$	0.96%	0.92%	1.05%	0.83%
$c\text{-}2\text{-}C_4H_8$	0.69%	0.81%	0.97%	0.80%
$t\text{-}2\text{-}C_4H_8$	0.98%	1.13%	1.36%	1.14%
$i\text{-}C_4H_{10}$	2.68%	3.20%	4.31%	4.59%
$N\text{-}C_4H_{10}$	0.38%	0.50%	0.65%	0.63%
C5 - 430°F	39.53%	42.36%	49.10%	52.67%
430°F - 650°F	23.29%	22.30%	18.75%	18.92%
650°F - 800°F	10.71%	9.03%	6.06%	5.27%
800°F +	3.24%	2.75%	2.17%	1.74%
Coke	5.73%	5.13%	4.28%	3.73%
Material Balance	97.93%	98.03%	96.59%	97.10%

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Table 3
Measured Aniline Point - Wt% Results

	ANS VGO Wt% FF	Athabasca Wt% FF	HT Athabasca Wt% FF	Kerrobert Wt% FF
Fresh Feed Rate: MBPD	68.6	68.6	68.6	68.6
Riser Outlet Temperature °F	*971*	*971*	*971*	*971*
Fresh Feed Temperature °F	503	503	503	503
Regenerator Temperature °F	1334	1609	1375	1562
Conversion	72.28	52.15	67.41	56.54
C_2 and Lighter	4.14	8.18	4.53	7.70
H_2S	0.54	1.37	0.12	1.18
H_2	0.18	0.21	0.22	0.25
Methane	1.35	2.67	1.65	2.66
Ethylene	1.00	1.37	1.31	1.51
Ethane	*1.07*	*2.55*	1.23	2.11
Total C_3	5.29	3.81	5.65	4.41
Propylene	*4.17*	3.10	4.43	3.55
Propane	1.12	0.71	1.22	0.86
Total C_4	8.86	5.76	8.38	6.55
Isobutane	2.59	1.47	2.97	1.81
N-Butane	0.68	0.22	0.68	0.30
Total Butenes	5.59	4.07	4.73	4.44
Gasoline (C_5-430°F)	48.47	28.57	43.32	32.08
LCGO (430-650°F)	21.46	33.99	27.56	31.75
HCGO + DO (650°F+)	6.26	13.86	5.03	11.69
Coke	5.50	5.83	5.53	5.82
API Gravity	21.7	13.8	22.4	15.5
Aniline Point: °F (Measured)	168	110	133.4	119.0
Product Value: $/BBL	Base	-3.00	-0.70	-2.23

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Table 3A
Measured Aniline Point - Vol% Results

	ANS VGO Vol% FF	Athabasca Vol% FF	HT Athabasca Vol% FF	Kerrobert Vol% FF
Fresh Feed Rate: MBPD	68.6	68.6	68.6	68.6
Riser Outlet Temperature °F	971	971	971	971
Fresh Feed Temperature °F	503	503	503	503
Regenerator Temperature °F	1334	1609	1375	1562
Conversion	73.85	53.01	68.48	57.56
C_2 and Lighter, Wt% FF	4.13	8.10	4.83	7.70
H_2S	0.54	1.37	0.12	1.18
H_2	0.18	0.21	0.22	0.25
Methane	1.35	2.87	1.65	2.65
Ethylene	1.00	1.37	1.31	1.51
Ethane	1.07	2.38	1.23	2.11
Total C_3	9.41	7.15	10.01	8.18
Propylene	7.37	5.79	7.81	6.54
Propane	2.04	1.35	2.20	1.64
Total C_4	13.79	9.35	13.05	11.57
Isobutane	4.26	2.40	4.86	3.21
N-Butane	1.08	0.35	1.07	0.53
Total Butenes	8.46	6.60	7.13	7.83
Gasoline (C_5-430°F)	58.48	35.35	51.58	39.49
LCGO (430-650°F)	20.78	34.74	27.08	32.08
HCGO + DO (650°F+)	5.37	12.25	4.44	10.38
Coke, Wt% FF	5.50	5.83	5.53	5.82
API Gravity	21.7	13.8	22.4	15.5
Aniline Point: °F (Measured)	169	110	133.4	119.0
Product Value: $/BBL	Base	-3.00	-0.70	-2.23

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Table 4
Calculated Aniline Point - Wt% Results

	ANS VGO Wt% FF	Athabasca Wt% FF	HT Athabasca Wt% FF	Kerrobert Wt% FF
Fresh Feed Rate: MBPD	68.6	68.6	68.6	68.6
Riser Outlet Temperature °F	*971*	*971*	*971*	*971*
Fresh Feed Temperature °F	503	503	503	503
Regenerator Temperature °F	1334	1464	1272	1383
Conversion	72.28	55.25	72.67	60.79
C_2 and Lighter	4.14	6.79	3.53	6.04
H_2S	0.54	1.40	0.13	1.25
H_2	0.18	0.17	0.18	0.16
Methane	1.35	2.14	1.21	1.86
Ethylene	1.00	1.19	1.07	1.20
Ethane	1.07	1.89	0.94	1.57
Total C_3	5.29	3.91	5.71	4.46
Propylene	4.17	3.18	4.60	3.57
Propane	1.12	0.73	1.11	0.89
Total C_4	8.86	6.63	9.83	7.64
Isobutane	2.59	1.70	3.07	2.09
N-Butane	0.68	0.25	0.75	0.38
Total Butenes	5.59	4.68	6.01	5.12
Gasoline (C_5-430°F)	48.47	32.36	48.27	37.29
LCGO (430-650°F)	21.48	31.09	23.19	28.28
HCGO + DO (650°F+)	6.26	13.68	4.14	10.93
Coke	5.50	5.86	5.33	5.46
API Gravity (Feed)	21.7	13.8	22.4	15.5
Aniline Point: °F (Calc.)	188	135.0	158.0	144.0
Product Value: $/BBL	Base	-2.50	+0.20	-1.53

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Table 4A
Calculated Aniline Point - Vol% Results

	ANS VGO Vol% FF	Athabasca Vol% FF	HF Athabasca Vol% FF	Kerrobert Vol% FF
Fresh Feed Rate: MBPD	68.6	68.6	68.6	68.6
Riser Outlet Temperature °F	971	971	971	971
Fresh Feed Temperature °F	503	503	503	503
Regenerator Temperature °F	1334	1464	1272	1383
Conversion	73.86	57.45	74.25	62.98
C_2 and Lighter, Wt% FF	4.13	6.79	3.53	6.05
H_2S	0.54	1.40	0.13	1.25
H_2	0.18	0.17	0.18	0.16
Methane	1.35	2.14	1.21	1.86
Ethylene	1.00	1.19	1.07	1.20
Ethane	1.07	1.89	0.94	1.57
Total C_3	9.41	7.33	10.10	8.27
Propylene	*7.37*	*5.93*	*8.10*	*6.59*
Propane	2.04	1.40	2.00	1.68
Total C_4	*13.79*	*10.79*	*15.26*	*12.18*
Isobutane	4.25	2.78	5.01	3.37
N-Butane	1.08	0.41	1.18	0.54
Total Butenes	*8.46*	*7.60*	*9.07*	*8.27*
Gasoline (C_5-430°F)	58.46	39.71	57.07	46.57
LCGO (430-650°F)	20.78	30.85	22.20	27.70
HCGO + DO (650°F+)	5.37	11.70	3.55	9.32
Coke, Wt% FF	5.50	5.58	5.33	5.46
API Gravity (Feed)	*21.7*	*13.6*	*22.4*	*15.5*
Aniline Point: °F (Calc.)	168	136.0	158.0	144.0
Product Value: $/BBL	*Base*	*-2.50*	*+0.20*	*-2.23*

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APPENDIX

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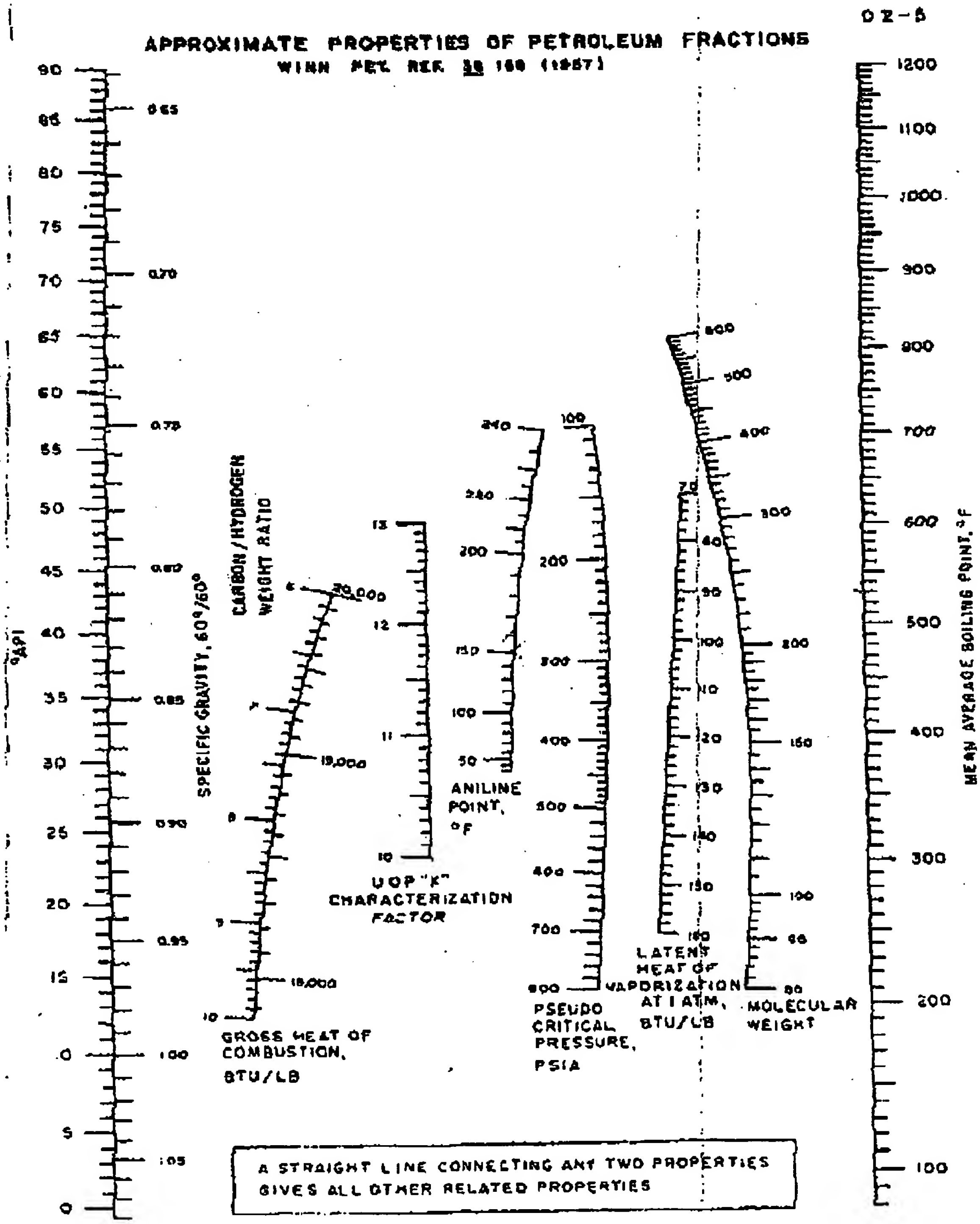
DZ-5
APPROXIMATE PROPERTIES OF PETROLEUM FRACTIONS
°API
SPECIFIC GRAVITY, 60°/60°
CARBON / HYDROGEN WEIGHT RATIO
GROSS HEAT OF COMBUSTION, BTU/LB
UOP "K" CHARACTERIZATION FACTOR
ANILINE POINT, °F
PSEUDO CRITICAL PRESSURE, PSIA
LATENT HEAT OF VAPORIZATION AT 1 ATM, BTU/LB
MOLECULAR WEIGHT
MEAN AVERAGE BOILING POINT, °F
A STRAIGHT LINE CONNECTING ANY TWO PROPERTIES GIVES ALL OTHER RELATED PROPERTIES

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